**Rotational Dynamics**

Horizontal Plane

1. A car of mass 800kg turns a corner on a flat road at 60km/h. What is the gripping force needed by the tires to keep a turning radius of 24m?
2. A carnival ride involves standing on a platform that spins. When the platform reaches a high enough speed, the floor of the platform drops and riders become suspended against the wall. The ride has a diameter of 26m, and a coefficient of friction (wall/human) is around 1.0, find the minimum speed needed to suspend the riders.
3. A girl of mass 42kg is on a merry-go-round of diameter 340cm. She spins the merry-go-round at a rate of 1 rotation every 1.8s and then jumps on. If she stands on the outer ledge of the merry-go-round, how much force must she use to stay on the merry-go-round? What direction must she apply this force?
4. During an accident, a truck swerves to avoid a raccoon and crashes into a store. At the accident scene, tire marks can be seen in an arc of radius 19m leading into the store. The truck has a mass of 1400kg and the frictional coefficient of the tires with the asphalt is known to be about 0.8. How fast was the truck going just prior to the accident?
5. A record of diameter 13 inches spins at 33 1/3 RPM. A fly of mass 0.5g lands on the record at the centre. The fly can withstand forces of up to 2.0x10-1 N and remain standing on the record. If the fly walks out slowly toward the edge of the record, will it make it to the edge without slipping? (1 inch = 2.54cm)

Rotation in a Vertical Plane

1. A 75cm rope is attached to a 2L bucket full of water. The bucket is twirled in a vertical plane. What is the minimum rate of rotation (measured in rotations per second) required to prevent water from spilling from the bucket?
2. A 4kg bucket of water is rotated in a vertical circle of radius 2m at the minimum rate required to keep the water in the bucket. Find the tension in the handle of the bucket at a) the bottom of the circle and b) the top of the circle.
3. A car goes over a small bump of radius 18m at a constant speed of 40km/h. A passenger of mass 86kg is sitting on a scale. What is the reading on the scale at the top of the hill?
4. A person standing on the equator is traveling around a huge circle of radius 6600km every day as the Earth spins. How much lighter is a person because of this? Give the difference as a percentage.

Rotation at an angle

1. A marble rolls around along the inside of a bowl in a horizontal circle of diameter 30cm. At that point the bowl is sloped at a 60o angle from the horizontal. Find the speed required to keep the marble traveling in a perfect horizontal circle. Assume friction is not a factor.
2. A tether ball is a ball at the end of a rope tied to a pole 3m tall. A player whips the ball around the pole with a speed of 2.7m/s and the string rises to an angle of 32o . Find the length of the string.
3. At the Scottish Highland Games in Maxville, an athlete swings an 18kg iron ball on a chain 60cm long, rotating three or four times before releasing the ball into the air. The competitor’s arms are 1.0m long, and they rise to an angle of 80o as he swings the ball. How much force does this impart on the competitor’s arms?
4. In a game of mini putt, a 150g golf ball must go around a frictionless semicircular bank of radius 80cm in order to get to the hole as shown. The bank is angled at 40o. What speed should the ball have to stay in the middle of the bank all the way around?

sdFront View

Side View

sdTop View

1. A turnpike onto a highway with a radius of 25m is banked at 8o from the horizontal. A sign near the turn says “SLOW! BLACK ICE -- \_\_\_\_\_\_ km/h Speed Limit”. What is the speed on the sign?